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Working and disability expectancies at older ages: The role of childhood circumstances and education

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ABSTRACT

The ability to work at older ages depends on health and education. Both accumulate starting very early in life. We assess how childhood disadvantages combine with education to affect working and health trajectories. Applying multistate period life tables to data from the Health and Retirement Study (HRS) for the period 2008–2014, we estimate how the residual life expectancy at age 50 is distributed in number of years of work and disability, by number of childhood disadvantages, gender, and race/ethnicity. Our findings indicate that number of childhood disadvantages is negatively associated with work and positively with disability, irrespective of gender and race/ethnicity. Childhood disadvantages intersect with low education resulting in shorter lives, and redistributing life years from work to disability. Among the highly educated, health and work differences between groups of childhood disadvantage are small. Combining multistate models and inverse probability weighting, we show that the return of high education is greater among the most disadvantaged.

1. Introduction

There is vast evidence that childhood disadvantages are negatively associated with labor market outcomes during adulthood, as well as early onset of chronic diseases, higher mortality, youth unemployment, negative income differences, and work disability (Case et al., 2002; Currie, 2009; Dannefer, 2003; Haas et al., 2011; Palloni, 2006). The ability to work at older ages is even more dependent on health and education. Both accumulate through selective processes affecting and reinforcing each other (Currie, 2009). As a consequence, childhood disadvantage may result in shorter working lives due to limited educational attainment and reduced ability to work because of health problems.

Concerns about length of working life have generated extensive literature investigating the determinants of labor market exits. Much of this research has focused on determinants of retirement in older age that are more proximate to the retirement transition, such as health, marital status, or spouse's employment status (e.g. Blau and Goodstein, 2010; Gruber and Wise, 1998; Henretta et al., 1993; Pienta and Hayward, 2002). This type of research is important for uncovering more immediate factors, but leaves the full picture incomplete because of two important aspects. First, while the timing of retirement is a key transition in life, age at retirement is a poor proxy for how long people work, as only highly atypical careers proceed without interruption until permanent retirement. Second, the

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study of determinants of retirement in proximity to the event ignores the complex link between retirement transition and other life course transitions that affect working trajectories.

While recent research has started to document the length of working life (Dudel and Myrskylä, 2017; Hayward and Grady, 1990; Skoog and Ciecka, 2010; Warner et al., 2010), the discussion, however, has not so far focused on the life-course predictors of working life expectancies. Most of these existing studies that examine health or labor force participation as functions of childhood disadvantages consider them as distinct processes. There are no studies investigating the reciprocal influence between health and labor market participation examining how childhood disadvantages accumulate over the life course to produce inequalities at older ages. The main research question is therefore this: Are older individuals who had disadvantaged childhoods working shorter than their advantaged peers because of more health problems? If this is the case, we expect disadvantaged individuals to have a shorter working life not only in absolute terms but also compared to life expectancy.

In this study we address this question by analyzing how childhood disadvantages accumulate over the life course to influence working and health trajectories at older ages in the US. These early-life exposures are important, as, based on the Health and Retirement Study (HRS) (e.g., Elo, 1998), about one out of three individuals rated their childhood family's financial wellbeing as poor, about the same share had one parent with less than eight years of education, and almost 13% reported that during childhood his/her family received financial help. Cumulative structural disadvantage theory provides us with the framework that drives our expectations on how childhood disadvantage selects individuals into later-life working and health trajectories. The theory conceptualizes the inequality in access to resources as an accumulation process leading socially and economically disadvantaged individuals to greater disparities over the life course (Case et al., 2002; DiPrete and Eirich, 2006; Geronimus et al., 2001). Likewise, education and labor market participation are age-dependent processes, parts of a system of stratified social reproduction of inequalities. From this theoretical perspective, disadvantages start to accumulate during childhood through limited schooling, fewer networking opportunities, and inadequate health care access.

Indeed, research has shown ample evidence that early-life disadvantage affects later life health (e.g. Haas, 2007; Montez and Hayward, 2014), and health is a primary determinant of labor force participation, especially at older ages (Bound et al., 1999). Therefore, the US's poor health profile is likely to have important implications for older-age work and disability expectancies. Disability here refers to a restriction in work activities, as work limitations are considered an integral part of the disability model (WHO, 2002). In terms of health, in the U.S., four out of ten working-age adults had at least one chronic condition in 2018 (CDC, 2020). Chronic conditions increase the risk of functional limitations and disability (e.g. Freedman et al., 2007). More than half of U.S. adults report at least one episode of work disability between ages 25 and 60 (Laditka and Laditka, 2018b). We base the analysis on the above theoretical considerations that suggest childhood disadvantages are linked to later-life inequalities in health and work, mediated through educational attainment.

We contribute to the literature in two ways. First, to the best of our knowledge this is the first study to assess the role of childhood disadvantages on the length of working and disabled life, jointly, treating work and disability as competing risks, mutually exclusive, in multistate models, which account for differential mortality. Examining the heterogeneity of the effects across gender, race/ethnicity, and education groups enables us to provide further insights on mechanisms. Second, we use a novel approach combining inverse probability weighting (IPW) and multistate modeling (Gran et al., 2015). Through this approach, we explicitly treat education as affected by childhood disadvantage. This reduces bias that can result from selection into education (i.e. people with different childhood disadvantages have different educational trajectories). In contrast, standard methods are generally limited to conditioning on childhood disadvantage and education, which does not account for the association between childhood disadvantage and education. Moreover, combining multistate models and IPW, we create a counterfactual scenario that enables us to assess the heterogeneity in the return to education by race/ethnicity.

We base our analysis on the US Health and Retirement Study (HRS), covering the years 2008–2014. We use incidence-based multistate methods to construct period working life tables for the years 2008–2014. The working life tables are used to derive the expected lifetime spent in employment at age 50 (or working life expectancy, WLE) and the expected lifetime spent in disability (defined as not employed, and with health problems) at age 50 (DLE). WLE and DLE at age 50 allow us to analyze how the influence of childhood disadvantages accumulates at older ages. Childhood disadvantages may affect working and disability trajectories indirectly through education. Assessing whether childhood adversities influence later-life outcomes when accounting for the indirect mechanism running through education is complicated by methodological challenges: education is itself affected by childhood circumstances, thus both mediate and confound the relationship between childhood adversities, education, and adult outcomes. We combine multistate methods with inverse probability weighting (IPW) to address these methodological challenges.

IPW overweight (underweight) individuals with characteristics observed less (more) frequently. This weighting procedure thus creates a sample of individuals that does not differ in the distribution of individual characteristics that may affect the relationship between childhood disadvantages, education, and later-life outcomes. IPW allows us to standardize the groups under comparison and to interpret the results accordingly. Furthermore, this method allows us to easily account for nonlinear relationships between covariates and the outcomes. We then use a counterfactual approach to evaluate the moderating role of education between groups exposed to different numbers of childhood disadvantages. Combining IPW and multistate modelling does not provide a perfect solution because it can only adjust for observed differences. Nevertheless, it offers an important contribution in minimizing selection bias, providing an alternative perspective to be read alongside results obtained with more traditional approaches. We discuss further limitations and requirements of our approach in the Methodological Considerations section.

Our findings indicate that number of childhood disadvantages is negatively associated with work and positively with disability, irrespective of gender and race/ethnicity. Childhood disadvantages intersect with low education, resulting in shorter lives and redistributing life years from work to disability. Among the highly educated, health and work differences between groups of childhood

disadvantage are small. We find also that the return of high education is greater among the most disadvantaged. This suggests that enhancing educational prospects has the potential to offer higher chances of better employment and healthier lives to the most disadvantaged.

2. Background

2.1. Childhood adversities, labor market, and health

There is vast evidence in the social science literature showing that inequalities at older ages, in many spheres of life as health and work, begin very early in life. The accumulation of advantages (disadvantages) originates during childhood when family resources influence individual's health and economic success (Ferraro et al., 2016; Willson et al., 2007). For instance, children born into low-income families are more likely to be low birth weight. Low birth weight is associated with childhood respiratory diseases, lower educational attainment (Conley and Bennett, 2000), and chronic diseases in adulthood (Barker et al., 1993). Individuals who experience poor health during childhood also earn less than their healthy peers (Haas et al., 2011). Later-life earnings (or income) provide only a partial perspective of the relationship between health and labor force participation, as they do not capture the accumulation of disadvantages of individuals who are out of the labor force. As an alternative, lifetime spent in employment (and out of employment) is a measure of labor market participation that provides a complete dynamic picture of working trajectories (Dudel and Myrskylä, 2017); it enables us to assess if differences in labor force participation and health remain as individuals grow older.

Working life expectancy (WLE) is an indicator that accounts for the underlying dynamics of employment, for the incidence of health problems in selecting individuals into inactivity/unemployment and into mortality. This measure allows us to estimate the expected number of years of life at age 50 and how those years are distributed in and out of work and out of work with disability. We use a common definition of WLE that is the expected number of years in employment (Dudel and Myrskylä, 2017; Hoem, 1977). Along with this measure, we estimate the number of years not in employment (including inactivity, unemployment, and retirement) and the number of years of disability (inactivity/unemployment with health problems up to age 70). WLE varies considerably by gender, education, and race/ethnicity (Dudel and Myrskylä, 2017; Skoog and Ciecka, 2010; Warner et al., 2010; Hayward and Lichter, 1998; Hayward and Grady, 1990). For instance, Dudel and Myrskylä (2017) show that in the United States, in the period 2008–2011, the number of years in employment at age 50 was greater for males than for females. Whites worked longer than Blacks and Hispanics, and disparities in educational attainment exacerbated the gender and racial/ethnic gaps. The higher incidence of retirement and disability among the lower educated is commonly considered the main determinant of the educational gradient in working life expectancy (Hayward and Lichter, 1998). To the best of our knowledge, there are no studies investigating WLE and DLE considering the role of life course predictors as childhood adversities.

2.2. Childhood disadvantages and long-term consequences

In this study, childhood adversities refer to disadvantages and stressors related to family background, experienced during childhood. Negative experiences affecting the psychological sphere, the material conditions, health, and in extreme cases episodes of physical abuse and violence, can materialize as health problems and limited participation, or scarce placement, in the labor market later in life (Haas et al., 2011; Smith, 2009). For instance, Case et al. (2005) find that children born into poorer families experienced poorer health in early adulthood and lower earnings in the middle ages. Haas (2006) found that children of disadvantaged social backgrounds were more likely to suffer poor health in childhood that, in turn, negatively affected educational attainment, occupational standing, and wealth accumulation. In a recent study, Fahy et al. (2017), found that children neglected or abused were more likely to be out of the labor force at age 55 and permanently sick. Montez and Hayward (2014) show that the higher the number of childhood disadvantages the greater the portion of life impaired.

Some of the negative childhood experiences can be more detrimental than others. However, it is the combination of more than one harmful exposure that results in particularly adverse outcomes (Montez and Hayward, 2014). We focus on the accumulation of adversities during childhood, primarily on circumstances reflecting family socio-economic status such as financial situation, and on parents' education, father's employment status and presence. Families in difficult economic situations are more often exposed to pathogenic environments (less favorable housing conditions, poor heating, worse sanitation, overcrowding) and the consumption of nutrient-poor diets, and more likely to live in unsafe neighborhoods, closer to poor quality schools (Currie, 2009; Evans, 2004). Economic conditions during childhood are a strong predictor of schooling completion (Duncan et al., 1998). Parent's education is highly correlated with children's educational attainment, through reducing financial difficulties (Lindeboom, Llena-Nozal and van der Klaauw, 2009), and with psychological development (Ermisch et al., 2004). A father's joblessness during childhood is highly predictive of the family's dependence on social benefits, and consistently associated with children's psychological distress (Ermisch et al., 2004). A father's absence negatively affects his offspring's well-being, and it is particularly negative on outcomes such as educational attainment, social-emotional adjustment and mental health (Mclanahan et al., 2013).

Altogether, negative childhood circumstances combine to determine advantages and disadvantages during childhood, and their accumulation determines the extent to which the family is able to provide material and non-material forms of capital to children. In particular, low educational attainment is consistently associated with a number of childhood disadvantages. Adverse experiences during childhood set in motion a developmental process that may negatively affect individuals during their whole lives. That is, the disablement process and the ability to work are rooted in childhood within the family.

We can therefore put forward a *first hypothesis*, that number of childhood disadvantages is related negatively to working life and

positively to disabled life. Irrespective of individuals' characteristics, childhood disadvantages within a stratified system may affect earnings, job stability, pension accumulations, health, and access to health care (Dannefer, 2003).

2.3. The role of education

Previous life experiences and circumstances, influenced by family background, are predictive of educational attainment (Bourdieu, 1977; Coleman, 1988; Elder, 1994; Mare, 1991; Morgan, 2005). Childhood health and family SES combine to determine the propensity of achieving high education (Mirowsky and Ross, 1998, 2005). In addition to individual characteristics such as mental abilities, educational attainment is strongly linked to childhood health and family SES; indeed, individuals of disadvantaged background are overrepresented in lower educational attainment (Haas, 2006; Palloni, 2006).

Education is a fundamental component of human capital, along with work experience; it provides individuals with highly-rewarded resources in the labor market. College graduates, for example, earn substantially more and are less likely to experience unemployment, compared to the least educated (Hout, 2012). The combined contribution of education and experience lower the risk of job loss and duration of unemployment. The duration of unemployment is much shorter for college graduates (Hout and Janus, 2011), who also suffered less severe consequences during the time of the Great Recession (Dudel and Myrskylä, 2017).

The debate on the causal interpretation of the effects of education on labor market outcomes is still open. Positive individual characteristics may be the determinants of success in education and at work. Cognitive abilities, behavioral traits, family background, and motivation affect labor market outcomes through education, directly and indirectly. Abundant research focusses on the role of cognitive abilities, generally measured by test scores, as a fundamental determinant of both educational attainment and labor success. Rosenbaum (2001) shows that both test scores and personal traits predict course grades in high schools and earnings ten years later. Behaviors, personality traits, habits, and styles combine with cognitive abilities in determining schooling and employment outcomes (Farkas, 2003). Studies using quasi-experimental designs find larger effects of education on earnings (Acemoglu and Angrist, 2000; Angrist and Krueger, 1991, 1992) than those obtained in studies controlling for observed abilities and traits. These findings suggest that the effects of education on earnings are large, despite that not all individuals in the population have the same chance to achieve high education; that is, high education is beneficial not only for those who are more likely to achieve higher education.

Many studies find that education predicts disability at old ages (Freedman et al., 2008; Ross and Wu, 1995; Schoeni et al., 2005). In the U.S. the decline in disability rates in the past decades was found among the better educated (Schoeni et al., 2005). Education is linked to differences in disability through three main pathways: increased material resources, psychological resources and health behaviors. The college educated live longer and healthier lives (Montez and Hayward, 2014), Lower-educated individuals have a higher likelihood of working in more physically and psychosocially demanding jobs (Warren et al., 2004), and physical and psychosocial demands predict poor health and disability.

All of these reasons suggest that, the returns to education may be different depending on socioeconomic background (Brand and Xie, 2010). Education is thus the central mechanism through which advantages and disadvantages, related to individuals social background, transfer over generations (Becker and Tomes, 1986). From such perspective, educational achievement and the returns on education are indicators of the intergenerational transmission of inequalities.

In accordance with this second mechanism we put forward our *second hypothesis*: number of childhood disadvantages is both moderated and mediated by education. Thus, we expect that at among high educated individuals, inequalities in work and health trajectories are less pronounced than for those less educated.

2.4. The intersection between race and gender

The dynamic of differential access to material and immaterial resources through life produces advantages (disadvantages) that accumulate and cause inequalities in health (Mirowsky and Ross, 1999) as well as in labor force participation (Marmot and Wilkinson, 2005). In the U.S., the opportunity structure, allocating resources unevenly according to gender and race/ethnicity, penalizes racial minorities, and women. The vast majority of past studies have investigated race/ethnicity and gender neglecting their intersection. However, the health and work consequences of childhood disadvantages are very different between racial/ethnic minorities and whites, as the opportunities are very different from women and men within and across racial/ethnic groups (Warner and Brown, 2011).

Racial/ethnic minorities have worse health outcomes than Whites, irrespective of the health indicator considered. The persistent lack of adequate resources and continued discrimination over the life course are responsible for the early development of chronic diseases and the higher rate of deterioration of functional health among racial/ethnic minorities (Geronimus et al., 2001). Warner and Hayward (2006) show that Whites live longer than Blacks, and that childhood socioeconomic status may be linked to differences in mortality between older Black and White men. Hispanics have similar or lower mortality risks than Whites but spend more years disabled (Haas et al., 2012; Hayward et al., 2014), suffering serious functional limitations for half of their remaining years of life after age 65 (Angel et al., 2014). Childhood socioeconomic status is an important determinant of these racial/ethnic disparities in later-life physical health, including older Blacks and Hispanics typically having worse physical performance than Whites (Haas et al., 2012).

Racial/ethnic minorities have more background disadvantages than do Whites, especially parental poverty, which is a very important predictor of economic success; Blacks earn much less than do Whites (Corcoran, 1995). Hispanics and Blacks are segregated in physically demanding occupations as agriculture, constructions, hotel, and domestic works (Toussaint-Comeau, 2006) and spend more time inactive than whites (Dudel and Myrskylä, 2017). Physical demands negatively affect health, though the strength of the effect is gender- and race-dependent (Fletcher et al., 2011). Health seems largely responsible for the differences in rates of labor force participation at older ages between educational and racial groups. Indeed, racial disparities in health are the main determinants of the

differences in labor market participation between older Blacks and Whites (Bound et al., 1996).

These racial/ethnic disparities in disability and work trajectories are likely to be different among men and women because of gendered processes surrounding opportunities and resources over the life course. There is evidence that childhood disadvantages affect differently the health of men and women, but not always in a direction consistently disadvantaging one over the other. For instance, newborn girls survive extreme mortality hazards better than newborn boys (Zarulli et al., 2018). Janicki-Deverts et al., 2012 found that children of highly educated mothers experience lower blood pressure in mid-life, but only in case of female children. On the other hand, women, but not men, with more disadvantaged childhoods were more likely to be overweight or obese in adulthood (Giskes et al., 2008; Khlat et al., 2009).

Gender differences in labor force participation are also well known. However, literature directly linking childhood disadvantage and work trajectories from a gender and race/ethnicity perspective is lacking. Work trajectories depend on early socioeconomic disadvantage and early environment (Damaske and Frech, 2016a), and traditional gender norms casting women as primary caregivers and responsible for the home have often corralled women into discontinuous careers. These norms were even more stringent for the cohorts in our study. Women's disadvantages combine with work opportunities that are race dependent to determine raced and gendered work trajectories, especially at entry. At exit, childhood disadvantages affect labor force participation at older ages through health, and there are clear differences in health at old ages between men and women and by race/ethnicity, as discussed above.

We expect that the unequal access and distribution of resources across race and gender in the U.S. will be reflected in the interplay between work and health at older ages. Our *third hypothesis* is the following: gender, education and race/ethnicity interact multiplicatively with education. This is especially important for racial/ethnic groups for which the share of individuals with disadvantaged childhoods is larger, i.e., among the most disadvantage Black and Latinos, the return of high education is greater than among their Whites peers.

3. Data

We use data from the Health and Retirement Study (HRS), a longitudinal survey of the US population aged 50 and over, running biennially since 1992 (Juster and Suzman, 1995). The HRS (Health and Retirement Study) is sponsored by the National Institute on Aging (grant number NIA U01AG009740) and is conducted by the University of Michigan. We use all waves from 1998 to 2014, starting with the first wave that collects all of our childhood measures. Spouses and partners of the respondents are included in our sample if they are 50 and older. Using all the waves results in more statistical power. However, we present results for the most recent period, 2008 to 2014, as the differences between the latest and the earlier period are not of interest for explaining the differences between groups of childhood disadvantage. Comparing results obtained for the periods 1998 to 2002 and those for 2003 to 2007 to the results for the most recent period 2008–2014, confirms that the results are not due to period effect but they hold for across the entire time windows included in the data. Results for the periods between 1998 and 2007 are available in appendix B.

3.1. Dependent variable

The outcome variable has four categories; three categories capture the labor force and health status at each age (transient states); one indicates whether the individual is alive (dead is an absorbing state). The three transient states are: working, disabled, and not working (includes inactive, unemployed, retired). To generate this variable, we use detailed working histories contained in the HRS, as well as information on activities in daily living (ADLs) and diagnosed morbidity (Crimmins and Hayward, 2004). As labor force status is available to the nearest month, we construct working histories based on annual transitions instead of the biennial reports in the RAND data (Dudel, 2017); annual transitions better capture the dynamics of working lives. To estimate the expected years of employment and disability, we use self-reported labor force status: working (full and part-time employed), not-working (inactive, unemployed, and retired) and disabled (disabled). We add to the group of disabled individuals younger than age 70, who are inactive or unemployed, and who report either at least one health problem measured by any limitation on the ADLs or any health condition among high blood pressure, diabetes, heart problems, and stroke (Hardy and Pavalko, 1986; Lievre et al., 2007). Thus, individuals out of the labor force and unhealthy are categorized as disabled, with no overlapping between the inactive and disabled categories.

We consider ADLs because they are informative of physical fitness, while the selected health problems highly correlate with cognitive functioning—two health dimensions that are indispensable to work. Because we focus on WLE and DLE over working ages and employment after age 70 is limited, we classify individuals not working (inactive, unemployed, and retired) as inactive and do not consider health components after age 70 as contributing to inactivity.

The indicator that we use captures health problems on a biennial base; we impute the non-survey year based on both the previous and following year and indicate a health problem only when both years indicate health problems. Our classification allows us to create a state space suited to capture the dynamic nature of labor force participation, accounting for the interplay between participation and health problems. Such classification additionally provides a measure of the health/work relationship that is less susceptible to self-justification bias, as may be the case when using self-reported information on health problems limiting work.

3.2. Independent variables

3.2.1. Childhood adversities

Following Montez and Hayward (2014), we define an indicator of childhood disadvantages, as the sum of the number of adversities experienced during childhood: self-reported childhood SES (1 = poor, versus 0 = else), father's occupation (1 = blue collar, 0 = else),

father's and mother's education, separately (1 = less than 8 years of schooling), father's economic contribution (1 = no), and before age 16: moving to a different place due to financial difficulties (1 = yes) and receipt of help because of financial difficulties (1 = yes). The variable 'father's economic contribution' includes father's long-term unemployment or absence from the household (death or otherwise). We imputed the lowest category in the case of missing education of the parents, and exclude less than 1% with missing values on other measures[1] (Montez and Hayward, 2014).

Childhood disadvantage is categorized (0–1, 2–3, and 4 or more adversities). This simple additive index reflects the accumulation of adversities and describes how the scope of disadvantages experienced during childhood influence trajectories later in life. The empirical distribution of the adversities supports such aggregation.[2] For example, more than 74% of individuals in the 0–1 category have the same distinguishing characteristic, a blue-collar father. In the 2–3 category, about 50% of individuals have lower-educated parents and blue-collar or non-economic contributing father. In the 4+ category, the distribution of the adversities is heterogeneous.

3.3. Covariates

Our models include age, gender, race/ethnicity, and educational attainment. For those individuals who die during the study period, the date of death is provided by relatives or from the National Death Index. We distinguish between non-Hispanic White, non-Hispanic Black, and Hispanic (for simplicity, White, Black, and Hispanic). Given the small size, we exclude from the sample the group of individuals commonly regarded as "other," which includes American Indian/Alaskan Native and Asian/Pacific Islander. Educational attainment is measured by the highest obtained degree, categorized in less than high school, high school diploma/general equivalency degree (GED), and Associate degree or higher.[3]

4. Method

4.1. Discrete event history and multistate models

We use a multistate approach (MSA) to analyze working trajectories and the interplay between health and work. The MSA models transitions between different states and has been used extensively in labor market research and demography (e.g., Dudel and Myrskylä, 2017; Hoem, 1977). It is an extension of classical event history analysis. While the latter focuses on a specific transition from a starting state to a receiving state, in the MSA individuals can move back and forth between several competing states (Piccarreta and Studer, 2019). The MSA is based on the probabilities of transitioning from one state to another; e.g., the probability of moving from employment to disability. Many useful quantities can be calculated through the transition probabilities, including the average lifetime spent in a specific state; for instance, we can estimate the average lifetime in employment, or the average lifetime in disability. Expectancies are very easy-to-grasp measures, they are well suited to assess inequalities and disparities between groups, and allowing us to show how (dis)advantage accumulates (Hayward and Lichter, 1998).

In our application of the MSA, individuals can move between the labor force and health states (working, not working, disabled), and eventually end up in the 'absorbing' state dead; 'absorbing' means that the state cannot be left, in contrast to the others states, which are called 'transient'. The set of all states is called 'state space'. The state space we use for our model also covers aging, by combining age 50 to age 99 with each of the transient states; e.g., 'aged 68 and working,' 'aged 69 and disabled,' 'aged 70 and not working'. We assume that at age 100 all individuals that are still alive die.

In each year, movements between states are regulated by transition probabilities that we estimate using a set of discrete event history models (Allison, 1982). The state at time t+1 is a function of the state at time t, and covariates. We estimate the transition probabilities between states through multinomial logistic regressions. All models include age, period, education, and the number of childhood adversities. Age is modeled using a nonparametric smoothing spline (Yee and Wild, 1996), plus three dummies to capture discontinuities in the age schedules (Behaghel and Blau, 2012; Dudel and Myrskylä, 2017): at age 62–64 (early retirement), at age 65–66 (Social Security retirement age), and 67+ (late retirement). We also include period dummies (1998–2002 as reference, 2003–2007, 2008–2014) and education. Education is interacted with childhood adversities dummies because the effect of education is likely to be heterogenous across different childhood backgrounds. Estimates are obtained by stratifying the sample by gender and race/ethnicity, so that the modeling procedure implicitly interacts gender and race/ethnicity with all the variables included in the linear predictor.

The general equation is:

[1] After selecting our sample, the indicator of childhood adversities presents 130 missing values and the variable reporting health status during childhood additional 31 missing. Overall, there are 161 missing on 19,223 individuals.

[2] Using the same variables to compute the indicator of childhood adversities, we estimated a complex indicator of childhood adversities. Terciles of scores obtained through a factor analysis were compared to the simple indicators, as a result, categories and terciles essentially were overlapping.

[3] Recent studies investigating the relationship between health and educational attainment found significant differences between individuals with some college and college degree and higher. This evidence is mainly important for more recent cohorts compared with those analyzed in this HRS sample. However, we conducted two sensitivity analyses moving individuals with some college in a case with the group of individuals having high school diploma/GED, and in the other case excluding these individuals from the sample. Results are robust to both specifications and available upon request.

$$P(y_t = m|y_{t-1}, \boldsymbol{x}) = \frac{\exp(\alpha + \boldsymbol{\beta}_{t-1} y_{t-1} + \boldsymbol{\beta}^T \boldsymbol{x})}{1 + \sum_{i=1}^{m} \exp(\alpha + \boldsymbol{\beta}_{t-1} y_{t-1} + \boldsymbol{\beta}^T \boldsymbol{x})},$$

where $y_t$is the status at time t (m = working, disabled, inactive and dead) and $\boldsymbol{x}$are the covariates (age, period, education, number of childhood adversities, plus dummies and interactions as specified above).

As stated in the data section, we provide results for the most recent period. Period life tables for gender and race/ethnicity subgroups for the period 2008–2014 are estimated through the predicted probabilities of the multinomial models. To obtain population-level estimates, we set categorical variables at their sample proportion (e.g., proportion of individuals with less than high school, with high school diploma/GED, and with Associate degree or higher, by group of childhood disadvantage); for group-specific estimates, (e.g., highly educated), the corresponding categorial variable(s) is set to 1. The probabilities that an individual aged x and in state j will be in state i at age x + 1, that is p(i|x, j), are organized in transition matrices P = [pij] separately for gender, race/ethnicity, and childhood adversities. The state space is made by all the pairs between states and ages, from age 50 to 99. From the resulting transition matrices, P, we obtain the fundamental matrix, which is the tool through which time spent in each state is obtained (Kemeny and Snell, 1983; Taylor and Karlin, 1998). Further details on the estimation procedure are provided in the supplementary material.

We estimate percentile bootstrap confidence intervals based on 1000 replications to test differences at the 5 percent level (Cameron and Trivedi, 2005). We resample both life and working trajectories at the individual level, maintaining the complex survey structure of the data. Particularly, the resampling strategy reflects both the cohort structure and oversampling in the HRS study.

4.2. Inverse probability weighting

As described in the background section, there are systematic differences between individuals with different childhood backgrounds. For instance, the least disadvantaged individuals are over-represented among Whites compared to Blacks and Hispanics; the opposite is true for their most disadvantaged peers. As for childhood disadvantages, there are systematic differences between individuals with different level of education; individuals of different childhood backgrounds have different educational prospects at birth. In addition, this selection mechanism may produce heterogeneity in the effects of education on labor market outcomes among groups of childhood disadvantages. That is, if the mechanism determining educational levels among individuals varies with individual, family, and contextual characteristics, the benefits associated with increasing levels of education is expected to vary between individuals of different backgrounds (Card, 2001); that is the relationship between individuals characteristics and education is non-additive. The standard approach to remove any bias due to the differences in the distributions of covariate(s) is to adjust for all the covariates associated with the outcome. Therefore, regression adjustment is effective only if the effects of the covariates are linear in each group of childhood disadvantage within educational groups. Moreover, adjusting for characteristics such as education (mediator) that are affected by childhood disadvantages (exposure) may induce endogenous selection bias (Elwert and Winship, 2014).

To address the problem of selection and to account for the non-additive relationships between individuals' characteristics, childhood disadvantages and education, we estimate state expectancies using inverse probability weighting (IPW) (Robins et al., 2000). Based on observed characteristics, IPW overweights (underweights) individuals in the sample with characteristics observed less (more) frequently, in order to achieve statistical independence between groups of childhood disadvantages, education, and confounding variables. This creates a sample with balanced characteristics, in order to standardize both the distribution of childhood disadvantages and the distribution of education across groups of childhood adversities. This approach allows us to evaluate differences in working and health trajectories net of differences in education and of background characteristics. Having a balanced sample is desirable, but it does not authomatically translate into unbiased estimates. Indeed, IPW cannot correct bias due to unobserved characteristics. Despite there are unobserved characteristics that cannot be included in in the weighting equations, this approach offers several advantages. For instance, we can adjust for childhood health, which is affected by family circumstances, and in turn, affects educational attainment, and thus simple conditioning would cause selection bias. IPW enables us to summarize the observed confounding variables using a single weight. Through the weights, we include variables and their interactions, avoiding a problem of extrapolation and data sparsity that could have occurred if included in the regressions. More generally, we suggest that IPW is an appropriate tool to estimate transition probabilities in multistate models, adjusting for a wider set of characteristics that otherwise would not be feasible.

The weights are obtained estimating for each individual the probability of receiving the observed level of education, conditional on the covariates that 'select' individuals in their respective levels of education. The individual's weight is the inverse of these probabilitites. For example, individuals i, with a level of education (E) equal to e, and a set of the individual's characteristics **X** receive a weight w equal to:

$$w_i = \frac{1}{P(E_i = e_i|\boldsymbol{X}_i)}.$$

The denominator of the weights is obtained through a multinomial regression, in which the observed characteristics predict education level. From these weights, the stabilized weights are obtained by substituting the numerator of one with the proportion of individuals in the respective educational level. This change in the numerator makes the weights less variable, thus increasing statistical efficiency.

$$sw_i = \frac{P(E_i = e_i)}{P(E_i = e_i|\boldsymbol{X}_i)}.$$

To obtain these weights, we first estimated the probability of being in different levels of education according to gender, race/ethnicity, birth year, childhood health, and childhood adversity, separately by gender and with interactions between race/ethnicity and childhood adversity; additional interactions did not change the distribution of the estimated probabilities. In the model used to obtain weights, we pooled all the individuals in the sample, as education and baseline characteristics are fixed. The same procedure is applied to estimate weights to account for differences in the distribution of childhood adversities by gender, race/ethnicity, and birth cohorts. As education is a mediator of childhood adversities, the discrete event history models to estimate transition probabilities were weighted multiplying the stabilized inverse probability weights for both childhood adversities and education with the HRS sampling weights (Coffman and Zhong, 2012).

5. Results

Table 1 provides summary statistics for the analytical sample. Of the 19,062 individuals included in the sample, about 42% are men. Whites are over 78% of the sample, Blacks are about 14%, and Hispanics less than 8%. One out of three individuals experienced one or fewer adversities during childhood, while a quarter experienced four or more adversities. About 30% of the sample has education lower than a high school diploma. The share of individuals with higher level of education varies with gender. 47% of men, and 54% of women have a high school diploma/GED; whereas, only 17% of women and 25% of men have at least an Associate degree.

There is a clear association between childhood adversities and educational attainment: the higher the number of adversities the lower the prevalence of higher education. Among individuals with 4+ disadvantages, only 10% of women and 13% of men have at least an Associate degree, but 40% of men and almost 40% of women in this most-disadvantaged group have less than high school.

Table 1B in the appendix describes the number of transitions. About 86% of the individuals starting in the state working remain in the same state in the successive period; about 90% of those starting in the state not-working stay in that state.

The figure is slightly lower for the transitions starting in the state disabled, around 72%. The transitions to death are most frequent when starting in the not-working state (5.5%), as this group includes the oldest individuals.

5.1. Life expectancy at age 50 and years expected working, not-working, and in disability

Table 2 shows the total life expectancy at age 50 by gender and its decomposition by state. Among both men and women, working years decrease, disabled years increase, and total life expecntacy decreases with increaing number of childhood adversities.

Among men, those with the least childhood adversities have 30.1 years life expectancy, and those with the largest number of adversities have 28.8 years (difference 2.3 years). Working life expectancy was about 13 years among men who experienced no more than one adversity, and about 3 years shorter for their most disadvantaged counterparts. For disability, the pattern is reversed. Men

Table 1
Sample description by gender, race/ethnicity, and education.

	Men		Women	
Race/Ethnicity				
White	6375	80.0	8559	77.1
Black	977	12.3	1668	15.0
Hispanic	612	7.7	871	7.8
Total	7964	100.0	11,098	100.0
Number of childhood adversities				
0–1	2702	33.9	3906	35.2
2–3	3297	41.4	4783	43.1
4+	1965	24.7	2409	21.7
Total	7964	100.0	11,098	100.0
Education				
Less than High School	2235	28.1	3129	28.2
High School/GED	3781	47.5	6043	54.5
Associates+	1948	24.5	1926	17.4
Total	7964	100.0	11,098	100.0
Childhood disadvantages by levels of education				
Less than High School				
0–1	334	14.9	422	13.5
2–3	1005	45.0	1544	49.3
4+	896	40.1	1163	37.2
High School/GED				
0–1	1371	36.3	2388	39.5
2–3	1604	42.4	2599	43.0
4+	806	21.3	1056	17.5
Associate +				
0–1	997	51.2	1096	56.9
2–3	688	35.3	640	33.2
4+	263	13.5	190	9.9

Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

Table 2
Life expectancy at age 50 decomposed in years expected Working, Not-Working, and in Disability by gender and number of childhood adversities – for the most recent period, 2008–2014.

	Men			Women		
	Number of adversities			Number of adversities		
	0–1	2–3	4+	0–1	2–3	4+
Years						
Working	12.7	10.7*	9.5*	11.5	9.2*	7.6*
Not-Working	14.3	14.1	14.5	19.6	19.2	17.5*
Disabled	3.1	4.3*	4.8*	2.8	4.3*	6.4*
Total	30.1	29.1*	28.8*	33.9	32.8*	31.5*
% of lifetime						
Working	42	37	33	34	28	24
Not-Working	48	48	50	58	59	56
Disabled	10	15	17	8	13	20
Total	100	100	100	100	100	100

*Statistically significantly ($p < .05$) different from the group with 0–1 adversities.
Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

with disadvantaged childhoods can expect to live almost 5 years of their remaing life expectancy at age 50 disabled, while their advantaged counterparts roughly 3 years.

Among women, the patterns are similar. Life expectancy for the most disadvantaged women is 31.5 years, that is 2.5 years shorter than life expectancy for the least disadvantaged women. Most disadvantaged women are expected to spend less than 8 years working, roughly 4 years fewer than their advantaged peers. Contrariwise, the most disadvantaged women are expected to spend 6.4 years disabled compared to only 2.8 years for their counterparts who have at most one childhood adversity.

The analysis of the status-specific expectancies as a share of total life expectancy reveals that the most disadvantaged women can expect to spend around one-fifth of their remaining life expectancy disabled, and men about one-sixth of their remaing life. For the least disadvantaged men and women, the share of life expectancy in disability is much smaller, about one-tenth for men and even less for women. For the most advantaged men, the share of life expectancy at age 50 spent working is more than 40%. For the most

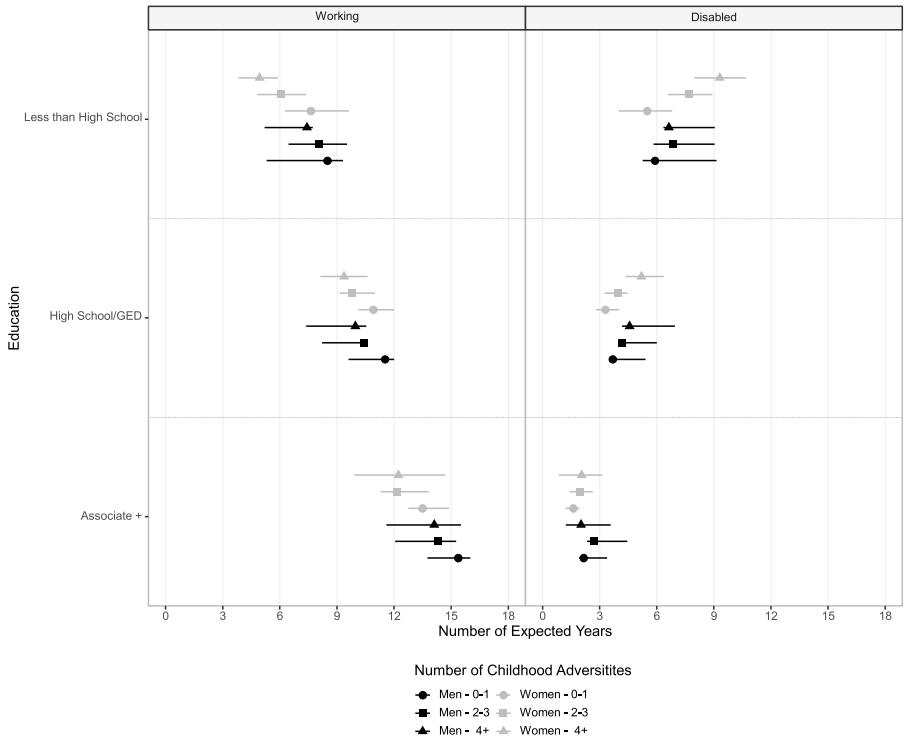

Fig. 1. Estimates and 95% confidence intervals for working and disability expectancies by education, gender and number of childhood adversities – for the most recent period, 2008–2014.
Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

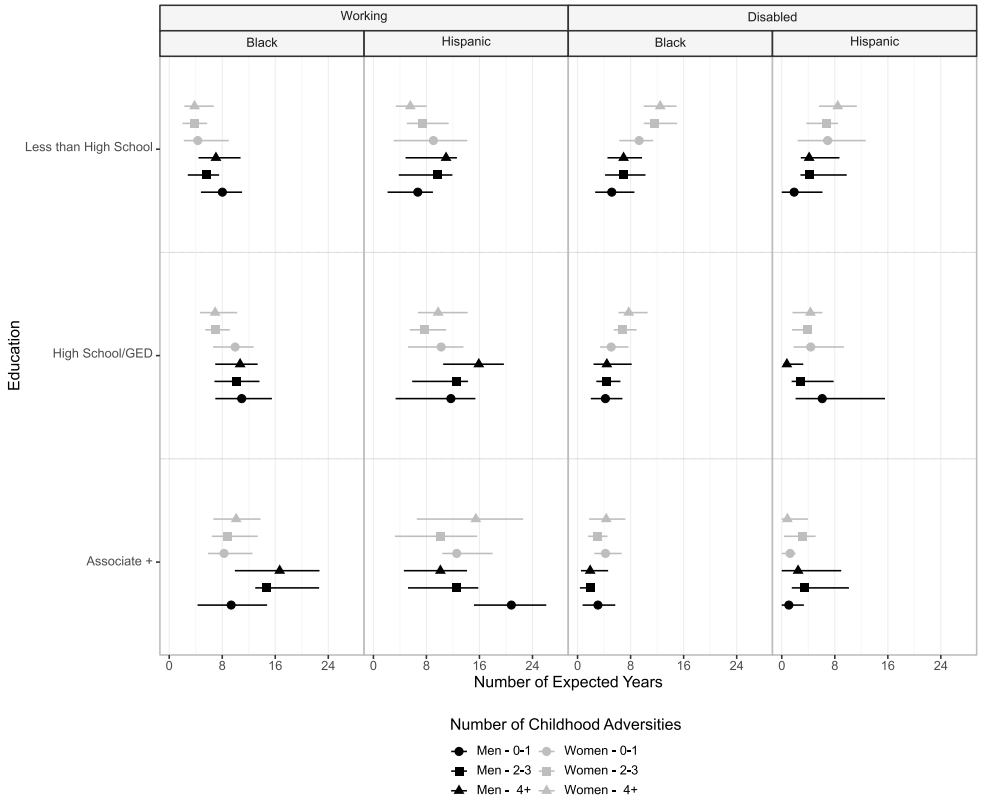

Fig. 2. Estimates and 95% confidence intervals for working and disability expectancies by education, gender and number of childhood adversities for Black and Hispanic – for the most recent period, 2008–2014.
Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

disadvantaged men, working life expectancy is about one-third of their residual life expectancy, which is roughly equal to that of the least disadvantaged women. Compared to their most advantaged counterparts, individuals with the most disadvantaged childhoods, irrespective of gender, are expected to spend fewer years working, more years disabled, and live shorter lives.

5.1.1. Childhood disadvantages and education

Fig. 1 shows state-specific expectancies by educational attainment. These results indicate that education largely mediates the relationship between childhood and adult outcomes, such that within a fixed level of educational attainment, childhood adversities predict expectancies only weakly. The most notable deviation from this pattern is women with less than high school education, among whom childhood adversities continue to predict more disabled and fewer working years. The interactions between childhood adversities and education nevertheless highlight the large differences in levels. Among men (women), those with the most disadvantaged background and less than high school education have the shortest working life, 7.5 years (5.0 years), which corresponds to less than one-third (one-sixth) of their remaining life. Men (women) with the least disadvantaged childhood and the most education have the longest working life, 15.4 (13.5) years — almost half (almost two-fifths) of their remaining life. Among men, individuals with the most disadvantaged background but the most education expect almost four fewer years in disability than the least disadvantaged who have the least education, among women about 3.5 years less. The health benefit of education seems greater for women than for men, especially among those most disadvantaged.

5.1.2. Childhood disadvantages, education, and race/ethnicity

Fig. 2 shows noticeable differences between expectancies' levels among Blacks and Hispanics; Tables 4 and 5 in appendix B provide the expectancies for all race/ethnic groups. Whites and Hispanics have longer life expectancy and fewer years of poor health, compared with Blacks. Whites show the highest number of expected working years, irrespective of gender. Both the negative gradient between childhood disadvantage and survival and work and the positive gradient between disadvantage and health is present at low levels of education, while at high levels of education, the differences are very small among Whites, reversed in the case of Blacks and Hispanic women. Also, in the case of Blacks, both men and women show a positive gradient between childhood disadvantages and expected years of disability, and a negative gradient between childhood disadvantages and working life expectancy. Among the most disadvantaged Blacks, the least educated men (women) expect to work 7.1 (3.8) years, while the most educated 16.7 (10.1) years. Among

the most disadvantaged Blacks, the least educated men (women) expect 6.9 years (12.5 years) in disability, while the most educated men (women) expect 1.9 (4.3) years of disability; that is fewer years of disability than the least disadvantaged higly-educated men (women) who expect 3.1 (4.2) years. Overall, the returns to high education appear higher for the most disadvantaged individuals, who also have longer life expectancy, 30.3 and 31.0 years, respectively, for men and women.

In the case of Hispanics, results are more mixed. Both men and women show longer life expectancy and relatively few years of poor health, compared to Blacks, and in many instances also compared to Whites.

Among the most disadvantaged Hispanics, the least educated men expect 11 years of working life, one year more than their most educated counterparts. Among women the corresponding figures are striking, with the least educated expected to work 5.6 years, while the most educated 15.5 years; that is almost 3 years longer than their least disadvantaged counterparts. At lower levels of education, the expected number of disability years increases with childhood disadvantages. For the least educated men (women) the expected number of years of disability decreases from 4.1 (8.5) to 1.9 (6.9), from most to least disadvantaged.

5.2. Counterfactual estimates of years expected working, not-working, and in disability at age 50

In this section, we show the results obtained by estimating state expectancies by childhood adversities using IPW. We estimate the transition probabilities on a pseudo-population in which the counfounders are independent of childhood adversities and education. We assign to all individuals the highest educational level (Associate+), in order to evaluate differences between groups of childhood disadvantage at comparable levels of education; in other words, we eliminate group differences, adjust for non-linear relationships between covariates, exposure and mediator, to assess differences in educational effects between groups of childhood disadvantage. Fig. 3 illustrates the results of the counterfactual scenario, contrasting the results obtained with the traditional multistate model.

5.2.1. Counterfactual education and childhood disadvantages

The counterfactual estimates of education result in a reduction in the number of expected years of disability. From the least to the most disadvantaged men the expected number of disability years are 2.5 and 3.4; that compared to the estimates obtained with the standard multistate models shows a decrease equal to 0.6 and 1.4 years, that is a reduction of about 20 and 30%. These values are similar for women; the correspondent number of disability years are equal to 2.0 and 3.9; That is a decrease equal to 0.9 and 2.5 years, corresponding to a reduction of about of 32 and 39%. For the number of expected working years, a similar pattern of a reversed trend emerges. The least disadvantaged men are expected to work 14.6 years, gaining about 1.9 (15%) working years compared to the corresponding estimates obtained with the standard multistate.

The most disadvantaged men expect 12.4 years, an increase of about 3 years (30%). In this case, the gender differences are small; for women the corresponding figures are 1.3 (11.3%) and 2.7 (35.5%) years. Overall, life expectancy increases for all categories of childhood disadvantage. The most disadvantaged benefit more than the least disadvantaged: men (women) are expected to live 31.0 (33.3) years, gaining about 2.2 (1.8) years, around 7.6 (5.7) %.

Results obtained using counterfactual high education by race/ethnicity are available in Table 3. Among Whites, the intervention in high education produces similar results. Most disadvantaged individuals expect a reduction of disability years from 4.7 to 3.7 among men and from 5.2 to 3.5 among women, a reduction of about 21 and 33%, respectively.

The gain in working years is about 2 years, for both men and women, respectively. Overall, the most disadvantaged men (women) expect to live 30.9 (33.9) years, about 2.0 (2.2) years more than the standard estimates. For the least disadvantaged the variations are smaller, both in disability and working years. Still, both men and women gain 1.2 years of life expectancy.

In the case of Blacks, the most disadvantaged men (women) expect 3.0 (6.2) years of disability, that is 2.1 (3.6) years fewer than expected from the standard estimates, while the least disadvantaged men (women) expect 2.4 (3.6) years of disability, 1.4 (1.8) years fewer. The gain in working life expectancy for the most and the least disadvantaged men is about 3 and 5 years, while their women counterparts gain 0.5 and 1.5 years. Life expectancies increase for men and decrease for women. Most disadvantaged men (women) gain 3.5 (−2.3) years, while least disadvantaged men (women) gain 2.0 (−3.3) years.

As the Hispanics sample is small, we estimate the results for only two groups of childhood disadvantages. For this ethnic group, the category of most disadvantaged includes individuals with 2 or more childhood disadvantages, while the least disadvantaged category remains at most one childhood disadvantage. The most disadvantaged men (women) expect 2.5 (3.2) years of disability, with a reduction of 0.8 (3.1) years compared to the standard multistate estimates. The least disadvantaged men (women) expect 3.3 (2.6) years of disability, 0.1 (1.7) years fewer than the corresponding multistate estimates. The working life expectancy for the most disadvantaged men (women) is about 13.6 (10.5) years, while the estimate for the least disadvantaged is about 14.2 (13.3) years. The least disadvantaged men (women) gain 1.4 (2.7) years, corresponding to an increase of 11 (25)%. For men, the counterfactual approach produces estimates of life expectancy shorter than those obtained with the traditional multistate, that is 1.5 years fewer for most and 2 years fewer for the least disadvantaged. For women, the life expectancy counterfactual estimates are much shorter than those obtained with the traditional multistate, 5.3 and 2.9 years fewer for the least and the most disadvantaged, respectively.

Counterfactual estimates are obtained using a pseudo-population in which differences between groups of childhood circumstances and educations are eliminated, as the weights balance the sample composition. This suggests that, given the small sample size of Blacks and Hispanics, the multistate estimates are driven by the characteristics of individuals who are overrepresented.

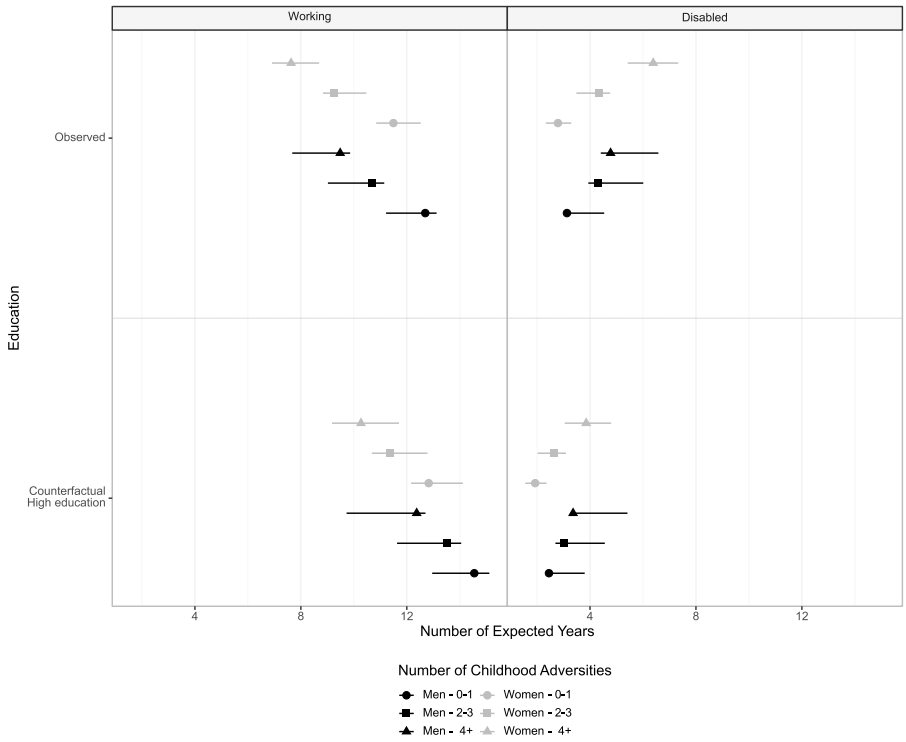

Fig. 3. Estimates and 95% confidence intervals for working and disability expectancies by number of childhood disadvantages, gender, comparing observed education vs. counterfactual high education (Associated+) – for the most recent period, 2008–2014.
Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

Table 3
Life expectancy at age 50 decomposed in years expected Working, Not-Working, and in Disability by gender, race/ethnicity, and number of childhood adversities – Counterfactual estimates obtained fixing educational attainment at Associate degree or higher – for the most recent period 2008–2014.

Gender	Race	Childhood adversities	Working	Not-Working	Disabled	Life expectancy
Men	White	0–1	14.4	14.3	2.6	31.3
		2–3	13.5	14.6	3.1	31.2
		4+	11.6	15.6	3.7	30.9
	Black	0–1	13.4	13.2	2.4	29.0
		2–3	13.3	13.0	2.9	29.2
		4+	14.6	13.3	3.0	30.8
	Hispanic	0–1	14.2	10.5	3.3	28.1
		2+	13.6	14.1	2.5	30.3
Women	White	0–1	13.1	20.0	1.8	34.9
		2–3	11.9	20.4	2.4	34.7
		4+	10.8	19.6	3.5	33.9
	Black	0–1	9.6	15.1	3.6	28.4
		2–3	7.3	15.8	5.0	28.2
		4+	7.3	15.0	6.2	28.5
	Hispanic	0–1	13.3	16.3	2.6	32.2
		2+	10.5	18.1	3.2	31.8

Source: Authors' own calculations based on the Health and Retirement Study, 1998–2014

6. Discussion

Following the abundant literature on the influence of childhood health and circumstances on adult health and mortality, a growing number of studies have investigated the relationship between childhood adversities and labor market outcomes (Fahy et al., 2017; Haas et al., 2011; Harkonmäki et al., 2007; Johnson and Schoeni, 2011). In these studies, the concurrent health and mortality processes are commonly not part of the analyses. Research investigating how childhood circumstances simultaneously affect later-life labor force

participation, health, and mortality, as interconnected processes, is missing. This study addresses this gap by examining how childhood circumstances affect working and health trajectories and their interplay, and to what extent education mediates and moderates the effect of childhood disadvantages.

Our results support the hypothesis according to which the higher the number of disadvantages during childhood, the lower the number of years expected working, and the opposite for the number of years in disability. This is in line with previous literature examining the relationship between childhood adversities and health later in life (e.g. Montez and Hayward, 2014), and of childhood adversities with work disability (Laditka and Laditka, 2018a; Shuey and Willson, 2017). However, our findings highlight the importance of estimating the effect of childhood disadvantages on the interplay between work and health. Shorter working lives are paired with longer period out of work with health problems. These patterns hold also when considering status expectancies as share of residual life expectancy. The findings hold both across gender and all racial/ethnic groups.

We find also evidence in support of our second hypothesis that education plays an equalizing role in mitigating the negative influence of childhood disadvantages. The least educated live shorter lives, spending more years disabled and fewer years at work than their most educated counterparts. Among the least educated, the differences by childhood disadvantage are more marked; in absence of individual resources linked to human capital, the least disadvantaged may rely on better family resources and abilities than the most disadvantaged.

These differences are particularly marked among women, suggesting that the explored mechanism between childhood disadvantages and education is only partially responsible for the inequalities in work trajectories and that other relevant factors intervene to shape the relationship between childhood disadvantage, education, and work. This finding concurs with other studies that the labor market disadvantage of women is probably linked to the process of family formation and of the timing of marriage (Brand and Xie, 2010; Damaske and Frech, 2016a; Haas et al., 2011).

Among the most educated, the association between childhood disadvantage and survival and health almost disappears, irrespective of gender. On the health benefits of education, there is abundant literature that reinforce our results (Hayward et al., 2015; Mirowsky and Ross, 1998, 2005; Montez and Hayward, 2014).

Although numerous studies have identified the beneficial effects of education among the most disadvantaged, only few studies have analytically addressed the non-linear relationship between individual characteristics, childhood disadvantages and educational groups. We capitalize on recent methodological developments to combine multistate and IPW. Our results show that traditional estimates tend to underestimate the effects of education and that the greatest returns to education are for those with the most disadvantaged childhood conditions. From the intervention on high education, women gain a larger reduction of disability years than men and enjoy longer lives; men gain more working years than women. These results are similarly observed for all races/ethinicities, though most prominently among Blacks. For Hispanics, results show a reversed pattern; that is, the least disadvantaged enjoy larger gains from high education. However, the interpretation must be cautious, due to a small sample size. Thus the answer to our third hipothesis is only partial.

Our findings obtained through the counterfactual intervention on education are supported by prior research. For instance, Schafer et al. (2013) show that individuals least likely to obtain a college degree are those who get the greatest health benefits from a degree. Brand and Xie (2010) find that the return to education on earnings was greatest among individuals least likely to obtain a college degree. These studies investigate two processes, (earnings) work and health that are highly interconnected and that we address simultaneously.

6.1. *Methodological Considerations*

Combining multistate modeling with IPW allows us to assess the causal effect of early life and education on later life, but the validity of causal claims requires several conditions be met. These are positivity, exchangeability, and consistency. Positivity requires that the probability of being in any of the categories of childhood disadvantage should be positive for all combinations of covariates and all educational groups, which hold in our data set. Exchangeability, or unconfoundedness, requires the inclusion of all relevant variables in the models, both for the multistate model and the model for the IPWs. In the case of mediation, the unconfoundness assumption is sequential unconfoundness, as both exposure and mediator must be unconfounded (Vanderweele, 2009). This condition likely is violated to some degree, e.g., we do not have measures of ability and motivation in the data we use, which could be influenced by early life and in turn affect education and later working life. That said, in our model estimates, their effect is captured by early-life disadvantages and education. Consistency refers to the unambiguous definition of the treatment, and thus that hypothetical interventions are well defined. In sum, while the requirements for causal claims are high, our estimates should, at least, give a good approximation, and combining multistate models with IPW helps to better understand the effects of an intervention on education, and thus how education mediates childhood circumstances.

There are further challenges that should be considered and that provide avenues for future reasearch. First, given the longitudinal nature of the data, individuals in worse health conditions are more likely to drop out of the study. This likely makes our estimates conservative, as individuals with disadvantaged childhoods are those who experience worse health conditions later in life and shorter lives, i.e., individuals with disadvantaged childhoods and in bad health are less likely to be observed than those with advantaged childhood in bad health. This will bias the differences between groups downward. Second, our measure of childhood adversities is based on retrospective information. The quality of retrospective measures of childhood conditions was assessed in several studies (Batty et al., 2005; Haas and Bishop, 2010; Krieger et al., 1998); many of these focused on the HRS sample (Elo, 1998; Haas, 2007; Smith, 2009a). The overall conclusion is that these measures are not without problems, but reliable. Third, there are other possible ways to define the state space to capture the length of working life. For instance, distinctions can be made to detail between full-time

and part-time employment. However, increasing the number of transient states would result in smaller sample sizes for sub-groups, increasing standard errors and thus making our results unstable.

The specification of the state space does not capture health problems after age 70, that is, individuals can be in the disabled state only from age 50 to 70. This means that more disadvantaged individuals have shorter working lives and more years of health problems before their final retirement. It is likely that these same individuals, who are sick at younger ages, experience more years of poor health at older ages. Yet, as working above age 70 is less common, considering health problems only up to this age reflects our interest in capturing the interplay between health and work that affects working and health trajectories. A different specification of the state space, for instance limiting the age range to 70, clearly would not change work and disability expectancies.

Our results do not automatically prove a causal effect of education on later-life work and health trajectories. The value of education as a means to achieve social mobility may be perceived differently between the most and least disadvantaged. For the most disadvantaged, it is very likely that high education is the only means to achieve upward mobility, while for the least disadvantaged, high education can be perceived as the 'norm'. If this is the case, the most and least disadvantaged would show different college preferences, the most disadvantaged toward, perhaps, more economically-rewarding disciplines. Previous research has offered alternative explanations, such as the "compensatory mechanism" (Ferraro and Kelley-Moore, 2003), and the "compositional variability argument" (Schafer et al., 2013). The former implies that the returns to education on health outcomes is greater for individuals starting at the most disadvantaged positions in childhood, as they have greater margins to improve. The latter argues that as the least disadvantaged individuals have better educational prospects, a larger share of them obtain the highest education compared to the most disadvantaged individuals. Thus, among the highest educated, the most disadvantaged group is more homogenous in terms of personal characteristics. In this case, educational attainment might be a consequence of positive individual characteristics, such as motivation, grit, resilience, and mental ability, that may also explain better health and work outcomes.

7. Conclusions

Among older U.S. individuals, childhood adversities and educational attainment affect life expectancy, and they also substancially influence work and disability expectancies. Highly disadvantaged individuals lived shorter lives, spending more years disabled and fewer years working than adults who experienced a more favorable childhood. Among the highly educated, the differences in all the expectancies, irrespective of childhood background, become negligible. The returns to education seem to be greater for individuals with the most disadvantaged backgrounds. Many studies have proposed and found evidence that investments in education sustain the health benefits of education (Montez and Hayward, 2014) and the economic effieciency of these investments at young ages (Heckman, 2006). We argue that investments in education can extend individuals' working lives, if not providing better jobs for all, at least fostering better health, which is a prerequisite for labor participation at any age. Our results emphasize the importance of a targeted support to particularly disadvantaged individuals who face major barriers to complete higher education. Enhancing educational prospects has the potential to offer to the most disadvantaged higher chances of better employment and healthier lives.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssresearch.2020.102447.

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